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energy update

1976

Report EI 77-2



Energy, Mines and
Resources Canada

Energie, Mines et
Ressources Canada

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FOREWORD

In the harsh winter of 1976-77, Canadians have had a fresh reminder of the importance of adequate energy and an adequate energy policy. Millions of Americans have suffered severe hardship because they haven't been able to obtain enough energy to meet basic needs. Canadians are fortunate that they have not had to share in this hardship. Indeed, emergency exports of Canadian energy were made available to some hard-hit areas in the United States.

We in Canada should not, however, conclude that, over the long-term, we will continue to enjoy relative energy abundance. It is going to be difficult and costly to keep ourselves secure. It is important that we rededicate ourselves to the goals established in the energy policy document, *An Energy Strategy for Canada*, which I released in 1976. If we do not do so, we could slip into the kind of crisis the United States has just experienced.


We, like the United States, are very heavily dependent on oil and natural gas. If precautionary action is not taken, we will find ourselves relying on foreign sources for a major portion of our petroleum supply. Individuals, institutions and governments collectively face a major test. If Canada is to reduce the risk and cost of heavy dependence on foreign oil, we must act to prevent energy waste, to make use of energy forms other than oil wherever feasible and to assure that, as our current oil supplies decline, we have the ability to tap more difficult sources such as the Athabasca oil sands.

In the *Energy Strategy for Canada*, the federal government indicated that Canada should attempt to cut its annual energy growth rate to less than 3.5 per cent. We will, however, have to undertake this task with real determination. Many federal government initiatives to save energy in transportation, buildings and government activities have already been announced and more will be forthcoming. Active and continuing provincial government support is necessary. And the individual, of course, has an extremely important role to play.

I would also like to see conservation incentives offered by oil and gas companies, and by electric utilities, just as they once offered incentives to their customers to increase their use of fuel and power. And I would like to see banks, insurance and loan companies offer savings and loan plans that would help people to do things to save energy. Only through a dedicated effort on all our parts can we hope to achieve the goal of self-reliance.

This document, coming one year after our Energy Strategy report, updates the Canadian energy scene and shows the challenges we face as a nation and as individuals.

Honourable Alastair Gillespie
Minister of Energy, Mines and Resources



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It is not the purpose of this booklet to present a broad statistical review of energy trends suitable for close analysis. The trends are indicated in simplified form in the STATISTICAL REVIEW section as charts and graphs that briefly present a selection of energy statistics. Where final official statistics for 1976 have not been available, it has been necessary to rely on estimates and these figures are identified as such.

Some of the energy-related events of 1976 are further discussed in the EVENTS IN REVIEW section. The fact that particular events are or are not mentioned should not be construed as a judgment as to their importance or lack of same.

Part 1. INTRODUCTION

Since 1973, most nations have had to revise drastically their assumptions about the sources and cost of energy. Some have been more successful than others in withstanding the shock caused by the escalation of international oil prices and in preparing for an era of high-cost energy.

In *An Energy Strategy for Canada*, published by the Department of Energy, Mines and Resources in 1976, the Canadian government identified how Canada and Canadians would be affected by the harder realities of a new energy age.

The first conclusion was that, because we were fortunate enough to enjoy a domestic source of oil, natural gas and other resources, we had a greater degree of freedom than some other countries in planning for new conditions. We have had some latitude to use more of our own oil, thus limiting our imports of increasingly high-cost foreign oil. Policies were devised to hold crude oil prices across Canada well below the world price, which many eastern Canadian consumers otherwise would have had to pay.

The advantages, however, will not sustain us over the longer term without a strong national effort to use energy more carefully and to develop our energy potential—a task which will be extremely costly. Failure to make the effort could mean a high degree of dependence on foreign oil in the next decade—a risky source in an uncertain world. One of the primary goals established in the Strategy was to make sure that our oil imports in 1985 do not exceed one-third of our requirements.

Canada has begun making the effort to reach this and other goals of the Strategy: to limit our energy growth rate to 3.5 per cent a year or less by 1985; to intensify the search for the oil and gas resources of the future; to maintain adequate supplies of Western Canada gas until northern resources are available. To help achieve these goals—to encourage energy thrift and to help meet high exploration and development costs—the Strategy said steps should be taken to raise domestic oil prices closer to world levels, though not necessarily all the way, and to assure that natural gas prices rose into an appropriate competitive relationship with oil.

As new data became available in 1976, a fresher picture of our energy situation emerged. The *Energy Update* is designed to convey this, and to make some brief observations about how the nation seems to be faring in relation to energy matters.

Each of us, for instance, is aware that we are paying more for the energy items on which we depend. But it may not be so clear that, even with 1976 price increases, the price paid for crude oil in the Canadian market remains roughly as far below the world price as it has been for several years. Few countries have been so fortunate.

Again, many may be unaware that over the long term the prices of such key energy items as gasoline, heating oil and electricity have not actually risen as much as such vital items as bread and milk. The *Energy Update* is intended to provide a closer look at points such as these (see chart on page 4).

In 1976, the continuing aim of keeping oil imports within reasonable limits was pursued in several important ways. Oil from Western Canada became available to Montreal refineries through a newly completed section of the Interprovincial Pipeline system, linking Sarnia and Montreal. This federally-backed project assisted the province of Quebec in holding down oil imports. To make this possible, oil exports to the U.S. were reduced. In addition, special conservation programs were launched in some Atlantic provinces, with heavy federal financial support. Prince Edward Island and Nova Scotia are dependent to a very high degree on foreign oil for generation of electricity as well as other uses.

In the Atlantic provinces, as in many parts of the country, there are opportunities to replace oil, in part, with other energy sources, notably coal and nuclear energy. An important federal goal is to co-operate with provincial governments in fostering development of these resources. A major step toward interprovincial co-operation, with federal backing, was an agreement in principle to establish a Maritime Energy Corporation to co-ordinate regional electrical development.

Obviously it remains of utmost importance to establish new sources of Canadian oil and natural gas. The record for 1976 is mixed.

As oil and natural gas prices have moved up, and as more money has become available for exploration, the effort to locate new sources and to develop known but costly sources has accelerated. In Western Canada, additions to natural gas reserves have been significant. Important exploration ventures in the Beaufort Sea and other frontier areas have gone ahead, but, despite some encouraging signs of natural gas, have not as yet yielded any overwhelming success. Oil results have been particularly disappointing. A sustained exploration effort, backed by the federal government, has confirmed that a substantial natural gas resource exists in and around the Arctic Islands, but further exploration will be required (and has been committed) to establish whether gas exists in sufficient quantity to make a pipeline practical.

Western Canada's heavy oil resource has in the past been overshadowed by conventional light oil. With prices rising to more favorable levels, new interest is being shown in the possibilities of substantially increased heavy oil production within the next 10 years, especially from the Lloydminster area of Saskatchewan and Alberta. Saskatchewan and the federal government are jointly financing studies on improved methods of recovery.

An expanded effort to pry more oil from the Athabasca oil sand deposits is also required and this goal is being jointly pursued by the Alberta and federal governments. At the same time, a higher rate of recovery from conventional oil fields is desirable, and is being encouraged by the Alberta government.

An increased flow of information on Canada's energy possibilities—frontier hydrocarbons, electrical power from uranium, hydro and coal—is vital in deciding our best options for the future. All information gained on the northern frontier will be important in making decisions on proposed systems to transport Arctic natural gas to southern markets. In order to gain the fullest possible information about these prospective systems, exhaustive hearings have been held by the National Energy Board and the Pipeline Inquiry Commission headed by Mr. Justice Thomas Berger.

Increasingly, the federal government will be examining energy forms which have not had wide use in the past but which, because they are self-renewing, may in the future become more important. This will be a factor in deciding research and development priorities in future. This research may improve the chances of using energy from the sun, the winds, and tides and from animal and vegetable matter.

An energy strategy has been adopted. It will require a number of energy policies. It will be expensive, will require structural adjustments to the manner in which our economic system functions, will necessitate a re-ordering of priorities, and will demand effective federal-provincial co-ordination on energy matters.

In the following section, various aspects of the energy situation are presented in graphic form. A summary of some of the major events of the year may be found in the final section.

Part 2: STATISTICAL REVIEW

ENERGY UPDATE 1976

ENERGY UPDATE 1976

The energy sector has experienced significant changes in the past few years. The demand for energy has increased steadily, and the supply of fossil fuels has become increasingly scarce. This has led to a rise in energy prices and a search for alternative energy sources. The government has implemented various policies to encourage the development of renewable energy and to conserve energy. The private sector has also made significant investments in energy research and development. The energy sector is expected to continue to play a major role in the economy in the years ahead.

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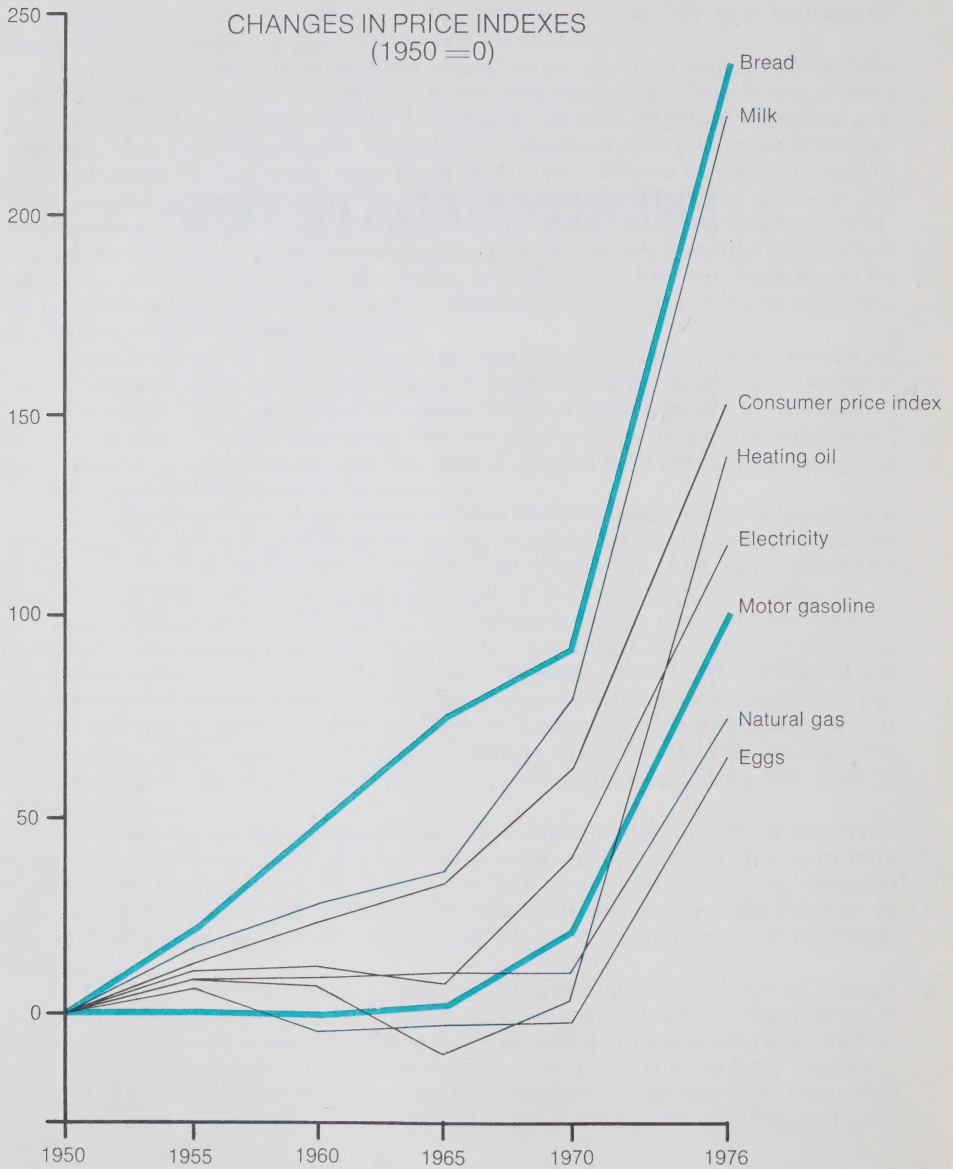
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AVERAGE ANNUAL CONSUMER PRICES FOR FOOD AND ENERGY ITEMS



Part 2. STATISTICAL REVIEW

CONSUMER PRICES

Oil and natural gas prices in Canada continued their rise during 1976 in keeping with the government's policy of bringing them closer to international levels. Higher prices are necessary to generate exploration funds, to promote more efficient use of energy and to help us adjust gradually to the more costly resources we will soon be dependent on.

As can be seen from the graph on the preceding page, over the last 25 years energy prices at the consumer level have been increasing more slowly than the prices of two basic foodstuffs, bread and milk. Since 1973, however, the prices of energy commodities such as heating oil, natural gas, motor gasoline and electricity have increased at about the same rate as the prices of those foodstuffs.

CHANGES IN PRICES

	1950	Actual	1976 Expressed in 1950 buying power (cents)
	(cents)	(cents)	
Heating oil (per gallon)	18	43	17
Natural gas (per thousand cubic feet)	93	184	74
Electricity (per 100 kilowatt-hour)	114	244	98
Motor gasoline (per gallon)	41	81	32
Milk (per quart homogenized)	17	55	22
Bread (per loaf)	13	44	18
Eggs (per dozen, Grade A large)	56	92	37

Source: Prices based on Statistics Canada Calculated Prices (Averaged) for September of each year and EMR Estimates.

See also **EVENTS IN REVIEW** section:

- Crude oil prices go up a total of \$1.75 per barrel (p. 23).
- Gas prices go up a total of 25.5 cents per million Btus (p. 23).
- World oil price increases (p. 23).

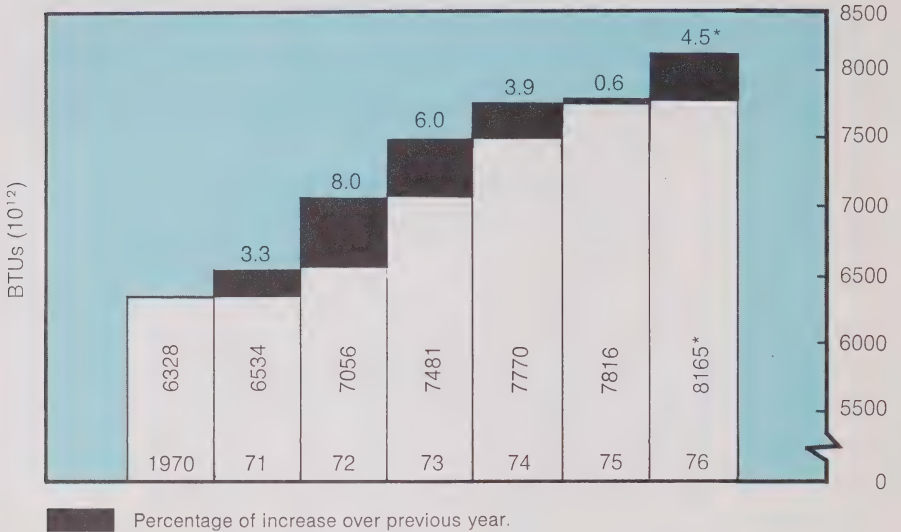
ENERGY CONSUMPTION AND CONSERVATION

A report from the International Energy Agency, published during 1976, showed Canada's energy demand growth rate to be one of the highest in the world. Yet Canada had entered 1976 with an energy consumption growth rate of .6 per cent for the previous year—a marked change over the annual average growth of 5.4 per cent for the previous 15 years. The decline was attributed mainly to a warmer-than-usual winter, economic recession, labor unrest and an increased awareness, on the part of the Canadian consumer, of the need for energy conservation. By the end of 1976, with an improvement in the economic climate and cold fall weather, the rate of use was on the rise again.

The graph below shows total Canadian energy use year-by-year through the 1970s, and gives an estimate of 1976 consumption.

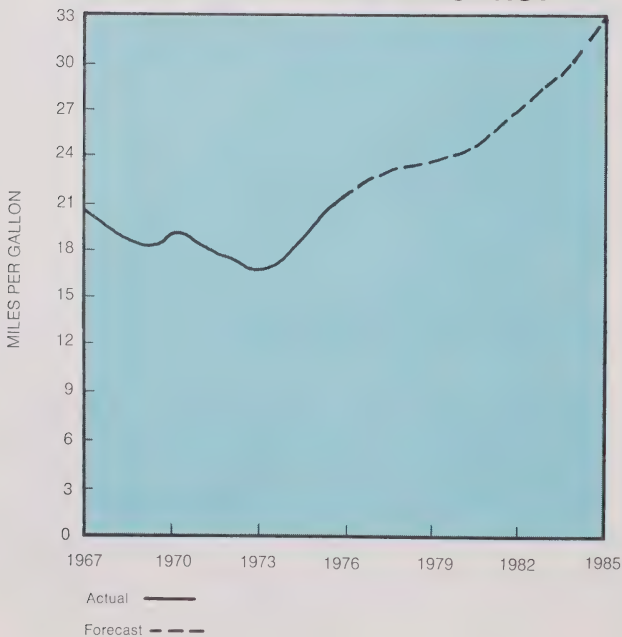
On pages 7 and 8 the rates of consumption for various energy commodities are indicated. Note the sharp increase in natural gas use between 1970 and 1975. In 1976, however, only a moderate increase over the 1975 rate of consumption was recorded.

CANADA'S TOTAL ENERGY CONSUMPTION RATES FOR THE 1970s



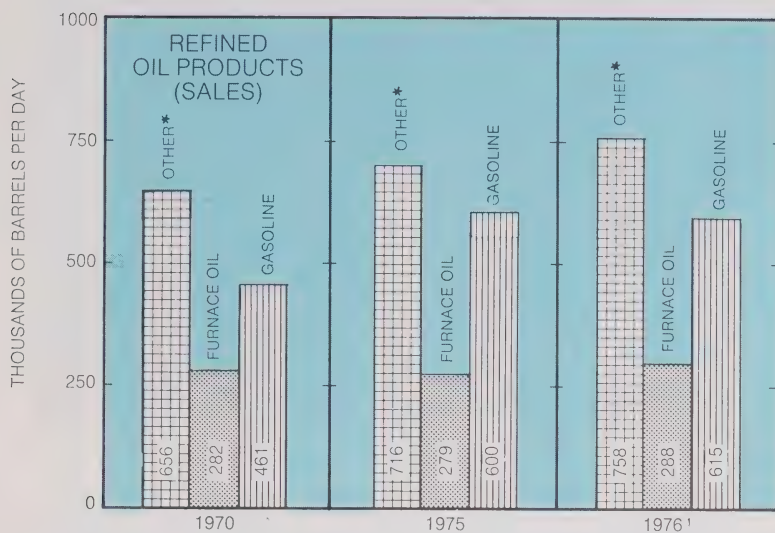
* Preliminary values.

NEW CAR ENGINE EFFICIENCY

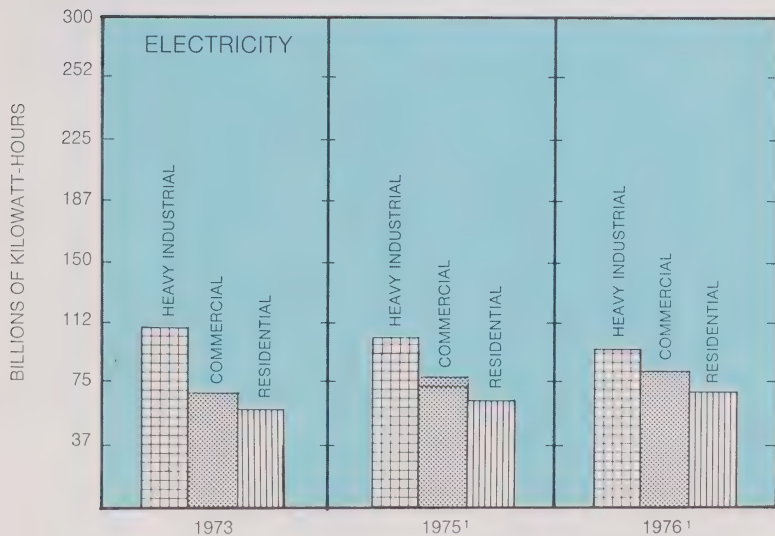


Automobiles consume 15 per cent of Canada's total energy. On average, Canadian cars in 1975 travelled 17.5 miles per gallon of fuel. By 1980, new cars sold in Canada, on average, must travel 24 miles per gallon of fuel and, by 1985, 33 miles per gallon of fuel under the federal government's new car mileage standards.

CONSUMPTION



*Other includes primarily diesel and heavy fuel oil.



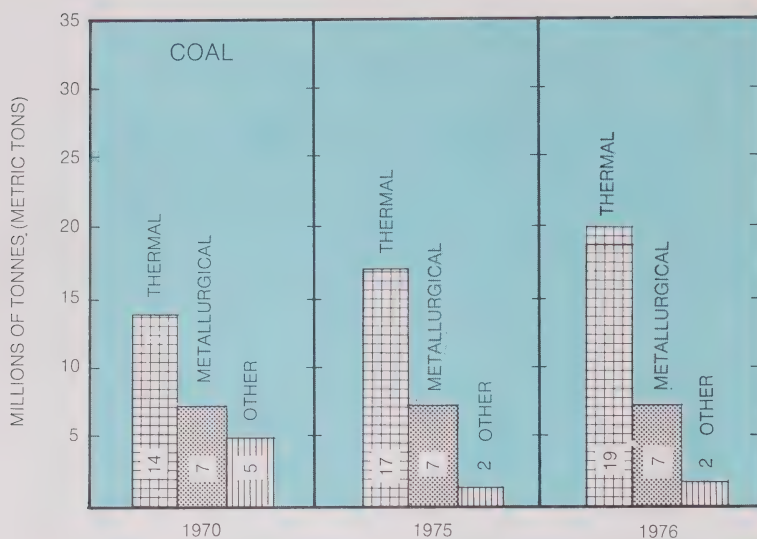
¹Estimated Values

Heavy Industrial includes electricity generated and used in own plant.
Commercial includes light industry and street lighting.

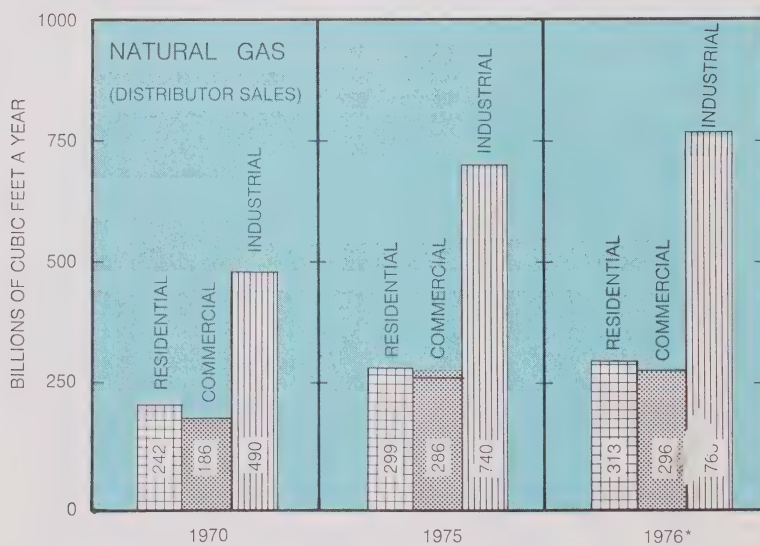
Figures prior to 1973 are not included as they are presented under a different system of categorization.

Note: figures have been rounded off

CONSUMPTION



THERMAL: electrical
OTHER: general industry and space heating



* Preliminary values

See also EVENTS IN REVIEW section:

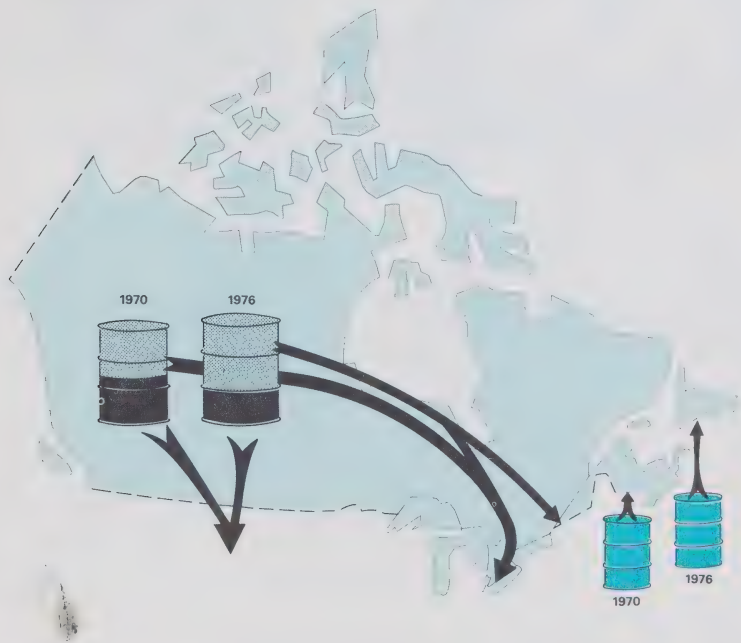
- Prince Edward Island grant (p. 23).
- Government's internal "Save 10" program (p. 23).
- Ontario's bus for industry (p. 24).
- New car efficiency standards (p. 23).
- New Proposals for National Building Code (p. 23).

OIL AND GAS IMPORTS, EXPORTS AND PRODUCTION

Canadian oil production and export volumes generally were down in 1976 compared to 1975 due to a lowering of the ceiling on allowable exports to the United States. (Export of petroleum products makes up the difference in the total exports shown in the chart below. The limit (crude oil only) was 385,000 barrels a day, as of the year's end, as compared to 510,000 at the beginning. Western Canadian oil can now be shipped to the Montreal market through the newly completed Sarnia-Montreal pipeline.

By January 1, 1977 the export charge for Canadian crude oil was: \$4.60 a barrel for light and medium crudes and condensate, \$3.75 a barrel for Lloydminster heavy oil blends and \$4.20 a barrel for other specified medium crude. A decline of 20 cents a barrel was scheduled for February, reflecting the increase in OPEC and Canadian prices and the declining value of the Canadian dollar.

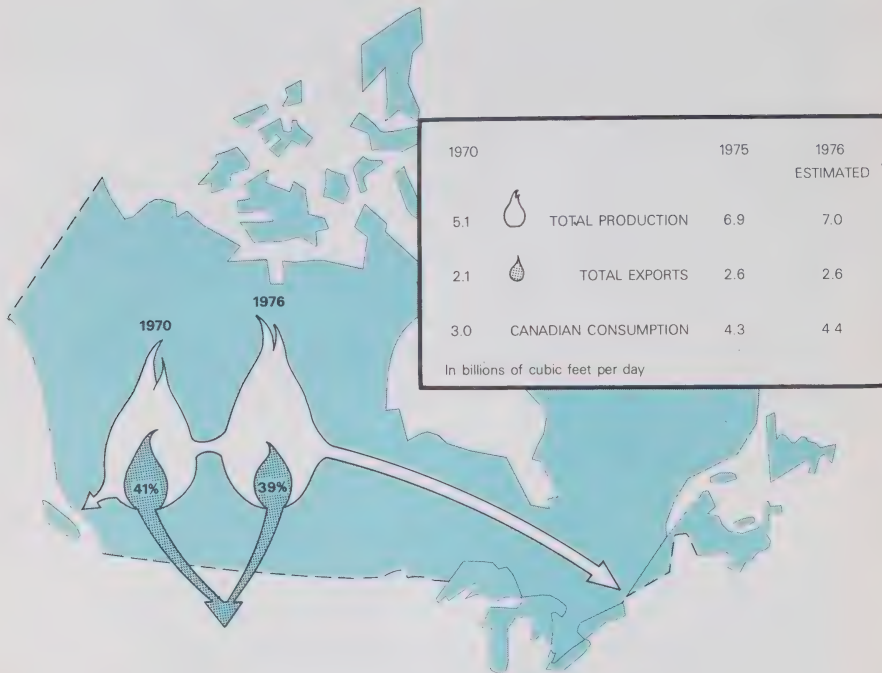
CANADA'S PETROLEUM IMPORTS AND EXPORTS



1970		1975	1976 ESTIMATED AVERAGE
1476 MB/D	TOTAL CANADIAN PRODUCTION	1734 MB/D	1603 MB/D
762 MB/D	IMPORTS	859 MB/D	752 MB/D
763 MB/D	EXPORTS	899 MB/D	638 MB/D
1475 MB/D	CONSUMPTION	1694 MB/D	1717 MB/D

MB/D: Thousands of barrels per day
Includes refined products and liquified petroleum gases

CANADIAN NATURAL GAS EXPORTS



As shown in the chart above, about the same amount of natural gas was exported in 1976 as in 1975. The border price of Canadian natural gas rose to \$1.94 per Mcf. It has been \$1.60 per Mcf at the beginning of 1976.

Canada's balance of trade for 1976 showed a deficit of \$600 million in oil earnings compared to one of \$52 million in 1975, owing mainly to a decrease in export volumes. However, our natural gas earnings for the year were estimated at \$1.6 billion compared to \$1.1 billion in 1975. As of the beginning of 1977, the price of imported crude at Montreal was \$14.10 compared to \$10.30 for a barrel of Canadian crude of the same quality at Toronto with the Canadian and U.S. dollars at par. Under a federal program of assistance to areas dependent on costly imports, crude oil importers receive compensation to enable them to buy at high world prices, but to sell at the lower domestic price. Total payments made since the start of the program were:

1974.....	\$1,334.1 million
1975.....	\$1,440.0 million
1976.....	\$ 967.4 million

The drop in 1976 was due to the opening of the Sarnia-Montreal pipeline, resulting in a decrease in imports.

See also EVENTS IN REVIEW section:

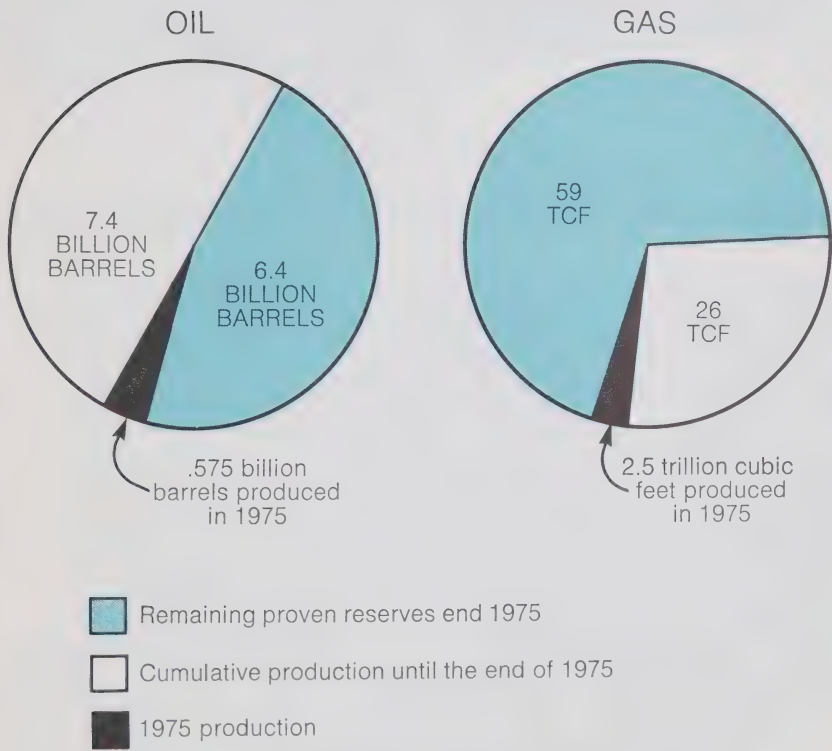
- New licence arrangement for heavy oil (p. 24).
- Completion of the Sarnia-Montreal oil pipeline (p. 24).
- OPEC prices go up (p. 23).

OIL AND GAS RESERVES

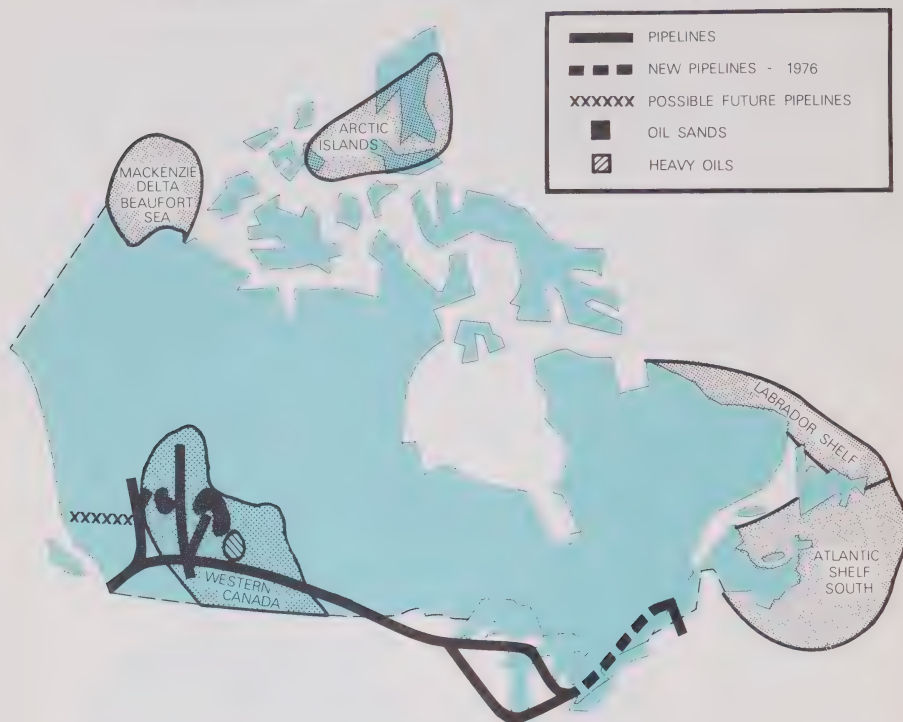
The charts below, based on estimates prepared by the National Energy Board, give the amounts of oil and gas recoverable from Canada's proven conventional reserves at the end of 1975. That is to say, the amount we know to be available from Canada's oil and gas fields in marketable form. The oil figures include both light and heavy (28° API and below) conventional crudes. They do not include natural gas liquids.

The amount of heavy oil included is only a few hundred million barrels—the amount recoverable from the Lloydminster area of Saskatchewan and Alberta based upon historic recovery factors and depressed market conditions. The figures do not reflect the potential for increased recovery from such heavy oil deposits through improved technology. In the case of Lloydminster oil alone, advances in technology and improved economic conditions could result in from 1.5 to 4.5 billion barrels recoverable of crude oil.

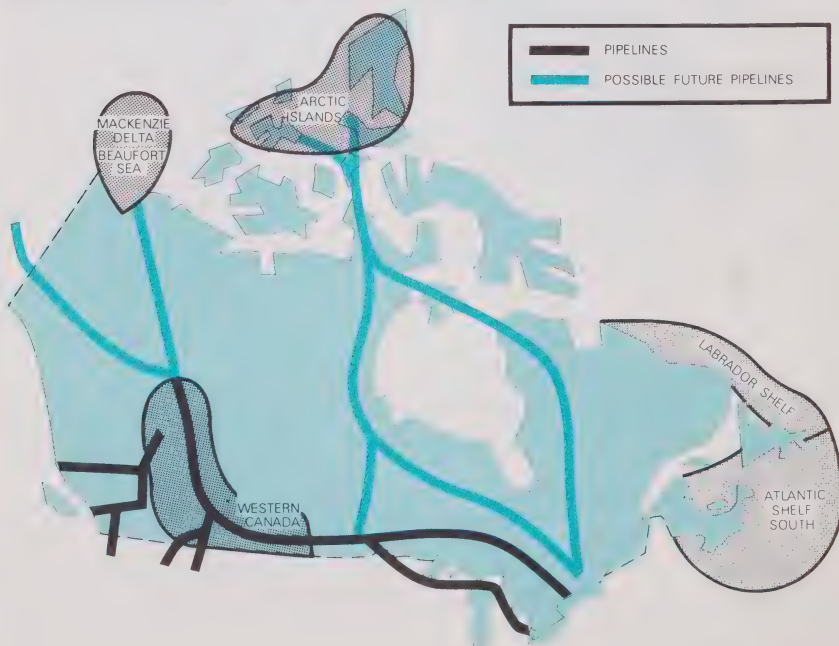
CANADA'S RESERVES



CANADA'S MAJOR OIL RESOURCE AREAS



CANADA'S MAJOR NATURAL GAS RESOURCE AREAS



EXPLORATION FOR OIL AND GAS

The charts on the preceding page indicate the major areas where oil and natural gas are being sought, on the basis of favorable geological characteristics. This does not, of course, mean that oil and gas will be found in producible quantity in all these areas.

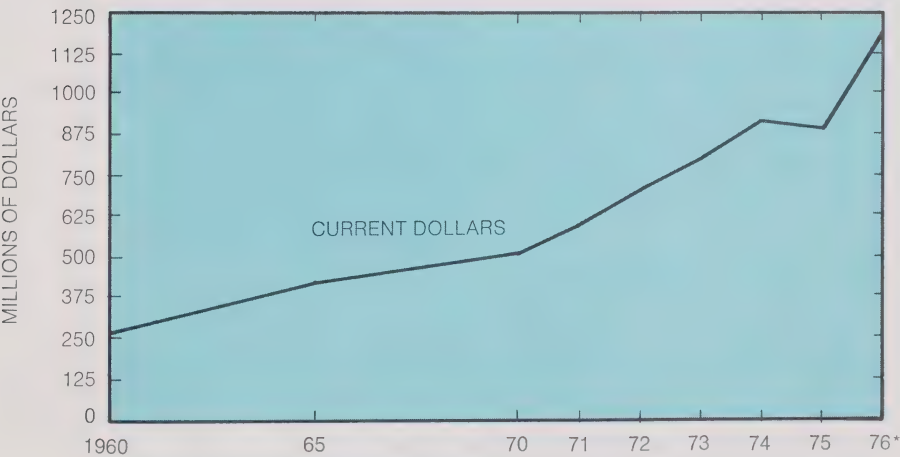
Exploration during 1976 was at an all time high in Alberta. Improved incentives along with higher prices and marketability, especially for natural gas, were basic factors. Both Alberta and British Columbia revised their royalty rates, and Saskatchewan increased its producer payments.

While drilling in the frontier areas was about the same as in 1975, there were a number of highlights. One was the Dome Petroleum Ltd. program in the Beaufort Sea, where offshore exploratory drilling began this year and the first indications of gas were found in the Tingmiark K-19 well. In the Arctic Islands, drilling continued in known gas-bearing areas. Another active frontier region was the east coast offshore where investment was about the same as in 1975. Petro-Canada become active in the area.

Exploration for gas in Western Canada continued its upswing with increased emphasis on drilling below 12,000 feet—into deep structures. In shallow drilling, about 5,000 wells were completed. Roughly 90 per cent of these were for gas with the balance for oil. The oil results continued to be disappointing.

The attack on the Western Canadian oil sands continued with progress on the Syncrude plant and federal-provincial studies of new financial arrangements for additional plants.

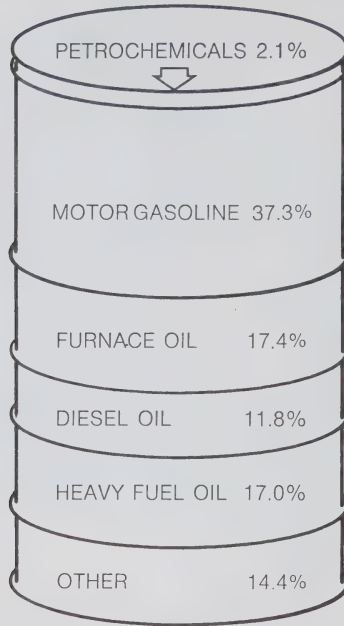
OIL AND GAS
EXPLORATION INVESTMENT
IN CANADA



Statistics from Canadian Petroleum Association.

* Estimated values.

AVERAGE CANADIAN YIELD FROM A BARREL OF PETROLEUM



Data is for 1975.

See also **EVENTS IN REVIEW** section:

- \$80 million to go towards Arctic exploration (p. 25).
- The National Energy Board pipeline hearings look at three gas pipeline proposals (p. 25).
- Syncrude Canada Ltd. project is 61 per cent complete (p. 26).
- Research money for Lloydminster heavy oil (p. 26).
- Federal-Maritime offshore resources agreement (p. 24).

OIL SANDS RESOURCES

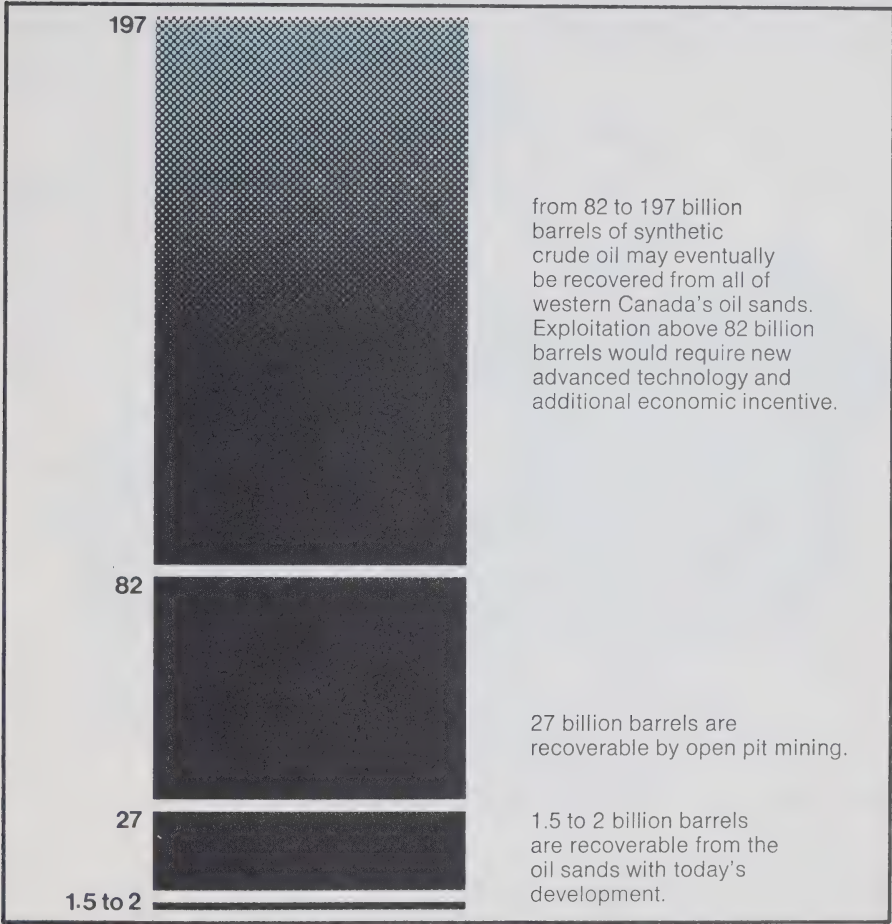
The figures on p. 15 give an indication of the amounts of synthetic crude oil which might be recoverable from bitumen—the raw hydrocarbon available from Canada's vast oil sands. Now only a small percentage of this large resource can be tapped. Unlike conventional crude oil, bitumen does not flow. It must be separated from the sand in which it is locked.

Development so far on the sands—the Great Canadian Oil Sands and Syncrude projects—are open-pit mining operations. Efforts are being made to find economically feasible methods to tap deposits at greater depths.

Once the hydrocarbon is separated from the sand there is the additional problem of upgrading and converting it to a synthetic crude product for marketing.

The oil sands figures include deposits at Cold Lake and of the Athabaskan type (at Buffalo Head Hills, Athabasca, Peace River and Wabasca). The Cold Lake area may eventually yield from 15 to 30 billion barrels of upgraded synthetic crude oil, and the Athabasca type deposits, from 40 to 140 billion barrels, depending on technological efficiency and economic conditions. Total bitumen reserves in place—those in the ground prior to recovery and upgrading—are estimated as high as 954 billion barrels.

THE OIL SANDS



COAL PRODUCTION AND POLICY

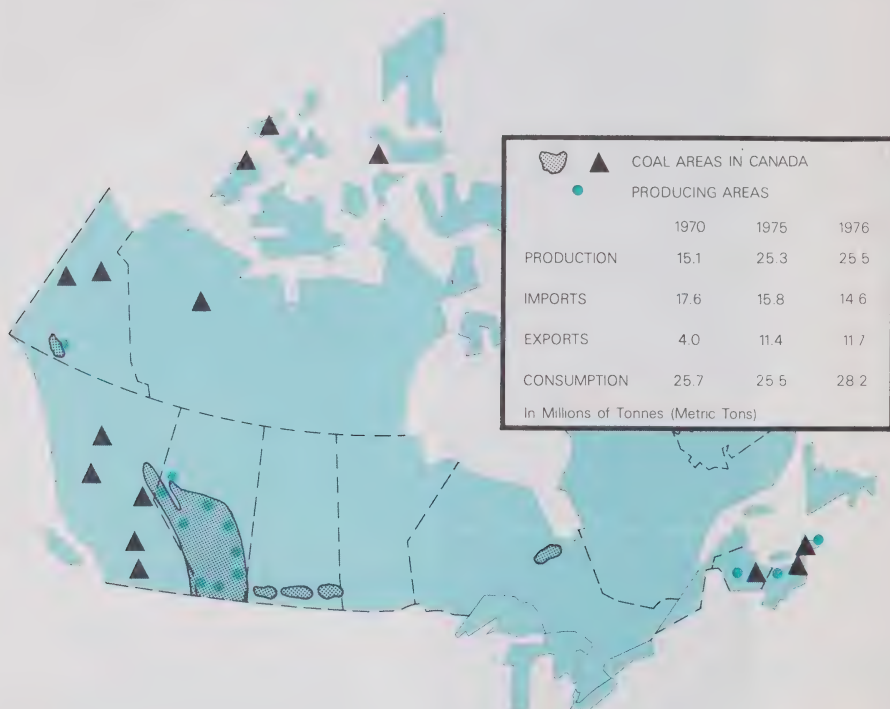
Generally speaking, Canada's coal production remained constant through 1976, as indicated in the chart on p. 16. Low growth resulted from mid-year labour interruptions, particularly at the large Fording Coal Limited operation in British Columbia. Production had recovered by the end of the year.

The Ontario steel companies and Ontario Hydro, Canada's major coal importers, showed more interest in Western Canadian coal. Applications from these buyers, and from Japan for coal from Alberta and British Columbia,

provided a continuing impetus for coal exploration and development. The Foreign Investment Review Agency granted approval for three major coal-mining developments in British Columbia.

Highlights in legislation included publication of the Alberta coal policy. EMR and six provinces began discussion of a national coal policy. Coal policy announcements are expected from the federal government and the governments of British Columbia, Saskatchewan, Ontario and Nova Scotia in 1977.

CANADA'S COAL IMPORTS AND EXPORTS - 1976



See also EVENTS IN REVIEW section:

- Negotiations begin for new national coal policy (p. 28).
- First major commitment of Alberta coal for Ontario Hydro (p. 28).
- New Alberta coal policy (p. 28).
- Canada's first *in-situ* coal gasification project gets underway (p. 31).
- DEVCO's new preparation plant starts production (p. 28).
- Possible developments in northeastern British Columbia (p. 28).
- EMR-B.C. hydro study completed on advanced electric power generation and coal gasification (p. 31).

URANIUM PRODUCTION

Increase in uranium exploration continued in 1976 with about 200 companies carrying out some \$40 million to \$50 million in uranium exploration work in Canada. The region where activity was greatest was the southeastern periphery

of the Athabasca Sandstone Basin, southeast of Lake Athabasca in northern Saskatchewan. Production data are indicated on the chart below.

The latest uranium resource estimates, based on 1975 figures, indicate an increase of 8 per cent over the 1974 figures, with a total of some 432,000 tonnes of uranium recoverable by present technology at prices up to \$40 a pound U_3O_8 (74,000 tonnes measured, 99,000 tonnes indicated and 259,000 tonnes inferred).

All three established Canadian uranium producers (Eldorado Nuclear Limited near Uranium City, Sask., and Denison Mines Limited and Rio Algom Limited at Elliot Lake, Ont.), were in the midst of major expansion programs which, together with several new operations, could boost Canada's annual uranium output to some 11,500 tonnes of uranium by 1984.

By year-end, Canada had committed some 75,000 tonnes of uranium for export into the early 1990s.

URANIUM PRODUCTION - 1976



Production figures are from Statistics Canada and are based on shipments from the mills.

See also EVENTS IN REVIEW section:

- Second uranium deposit discovered at Key Lake (p. 28).
- Saskatchewan announces uranium inquiry (p. 29).
- Atomic Energy Control Board investigates areas showing radiation emissions above background levels (p. 29).
- Joint panel to plan occupational and environmental health research program (p. 29).
- Tighter nuclear safeguards announced (p. 29).
- Canada gets Nuclear Liability Act (p. 29).

ELECTRICITY

Preliminary estimates show that Canada's installed capacity to generate electricity increased by 6,752 megawatts in 1976 with the major locations of expansion being Manicouagan 3, Que.; Lennox and Nanticoke, Ont.; and Mica and Kootenay Canal, B.C. This was an 11.2 per cent addition to capacity in service at the end of 1975 and included generating units that became operational in 1976 but had not been assigned to normal commercial service. Nine billion kWh, 3 per cent of total Canadian generation, represented net exports of electricity. The table below gives electricity generated, province by province.

The mid-1976 estimate for the year's electrical utility capital expenditures was \$4.474 billion—up 14 per cent from 1975 and representing 16.7 per cent of the total business capital expenditures for Canada.

Electrical costs increased across the country as the electrical utilities continued to revise prices to higher levels to offset rising fuel and capital expenditures. Increases varied from 10 per cent to 30 per cent, depending on regional cost factors and on the dates and adequacy of previous rate changes.

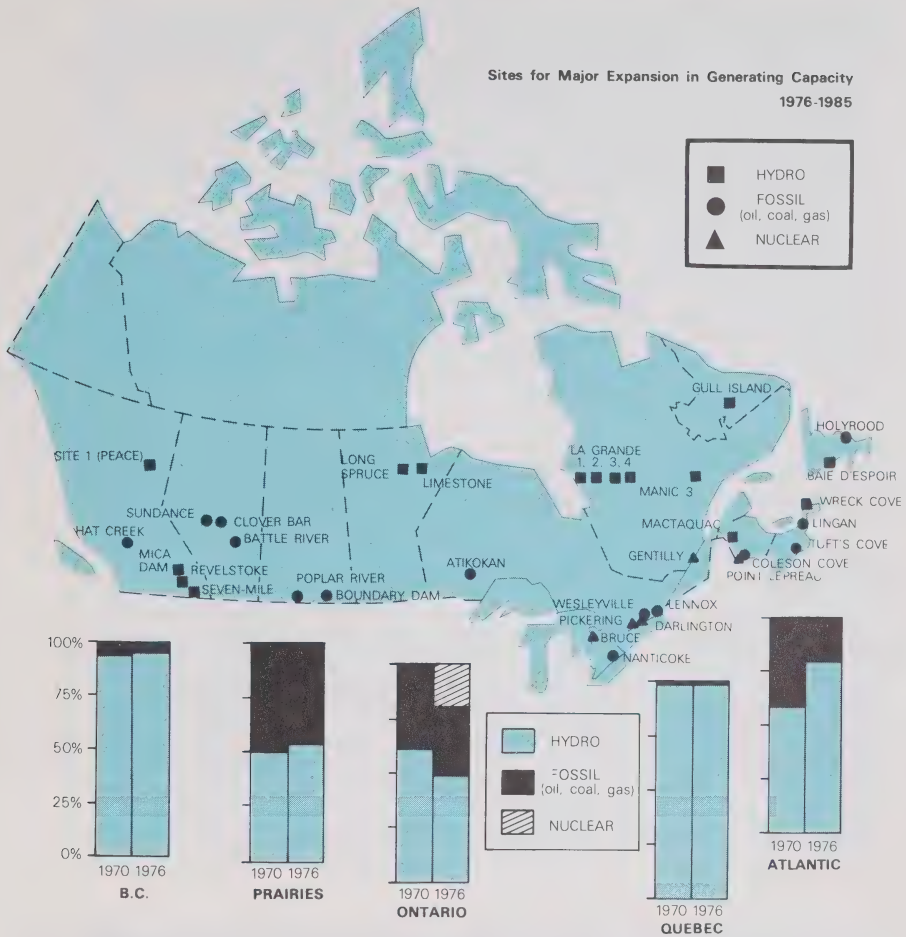
The cost pressures were especially acute in the two provinces that depend most heavily on imported oil to generate electricity—Nova Scotia, where oil-fuelled thermal plants provide over 60 per cent of the electrical supply, and Prince Edward Island, where they provide 100 per cent. Ontario, faced with predictions of brownouts by 1980 if the province does not restrain its electricity demand to a 6 per cent growth rate, started a million-dollar conservation blitz. In both Quebec and Ontario, rate structures came under scrutiny with interest shown in peak period and marginal pricing.

ESTIMATED GENERATION AND CONSUMPTION OF ELECTRICAL ENERGY IN CANADA, 1976

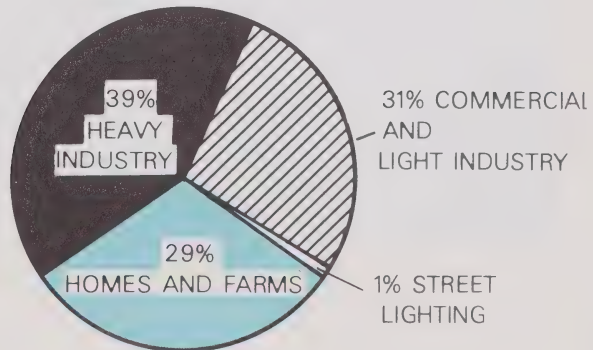
	GENERATION		CONSUMPTION	
	Millions of kWh	% of Canadian Total	Millions of kWh	% of Canadian Total
Newfoundland & Labrador	39,190	13.4 %	7,086	2.5%
Nova Scotia	5,663	1.9 %	6,037	2.1%
Prince Edward Island	445	.15%	445	0.1%
New Brunswick	6,663	2.3 %	7,533	2.7%
Quebec	77,698	26.5 %	94,202	33.2%
Ontario	87,237	29.7 %	95,932	33.8%
Manitoba	14,004	4.8 %	12,306	4.3%
Saskatchewan	7,515	2.6 %	7,378	2.6%
Alberta	15,779	5.4 %	16,092	5.7%
British Columbia	38,544	13.1 %	36,439	12.8%
Yukon and Northwest Territories	673	0.2 %	673	0.2%
	293,411	100%	284,123	100%

Note: A kilowatt (KW) - 1,000 watts - is a measurement of the rate at which energy is produced. A kilowatt hour (kWh) is the term used to express the amount of power consumed (1 kilowatt for 1 hour).

ELECTRICITY IN CANADA 1976 - 1985



CANADIAN CONSUMERS OF ELECTRICITY 1976



See also EVENTS IN REVIEW section:

- Agreement on a Maritime Energy Corporation (p. 30).
 - Renegotiation of Churchill Falls electrical agreement (p. 30).
 - Prince Edward Island will join eastern Canada power grid (p. 30).
 - British Columbia's Revelstoke dam gets approval (p. 30).
-

ENERGY RESEARCH AND DEVELOPMENT

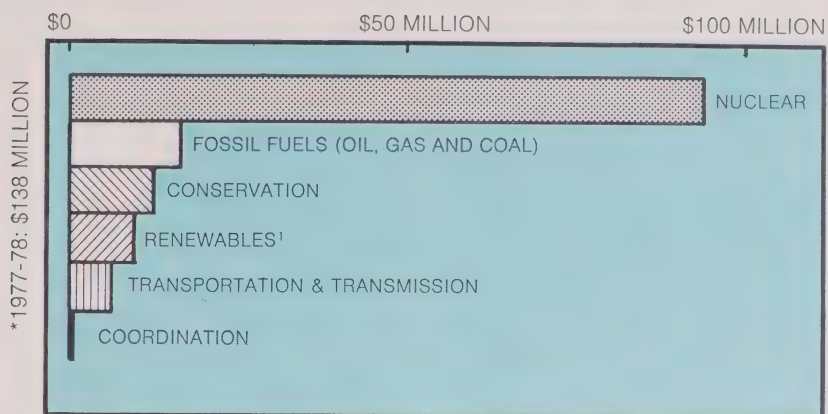
A national energy strategy for the future requires the contributions of scientists and technologists working in many areas of research. During 1976, the federal government continued to emphasize five priorities as shown in the chart on page 21: energy conservation, increasing domestic non-renewable energy production and substituting other sources for oil and gas, developing our nuclear capability, exploiting renewable energy sources, and improving energy transportation and transmission systems.

Canadian work in these areas continued to be funded through the federal research and development program, which is monitored by the Interdepartmental Panel on Energy Research and Development and co-ordinated by the Office of Energy Research and Development (R&D).

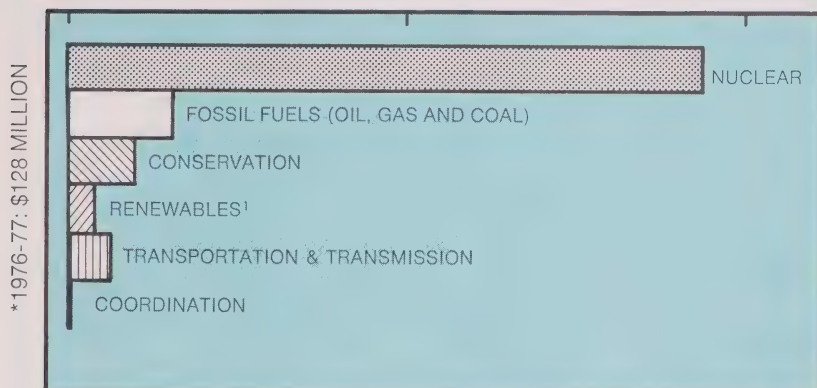
See also EVENTS IN REVIEW section:

- Federal energy R&D funding increased by \$10 million (p. 31).
- Canada to participate in international coal research (p. 31).
- International "Sharing the Sun" conference staged in Winnipeg (p. 31).
- Official opening of the P.E.I. "Ark" by Prime Minister Trudeau (p. 31).
- Federal contracts awarded for 14 demonstration solar houses (p. 32).
- Bay of Fundy tidal power economically feasible in right circumstances (p. 32).

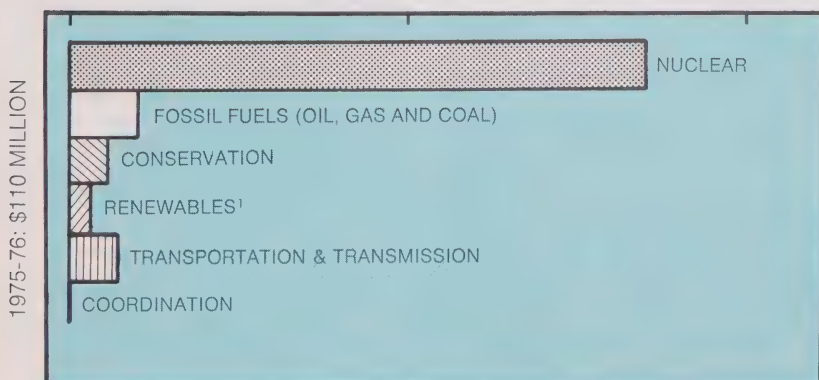
EXPENDITURE IN FEDERAL ENERGY RESEARCH AND DEVELOPMENT



¹Hydro, tidal, solar, wind, geothermal and biomass



¹Hydro, tidal, solar, wind, geothermal and biomass



¹Hydro, tidal, solar, wind, geothermal and biomass

* Estimates

Part 3. SOME EVENTS IN REVIEW

Oil and Natural Gas Prices

OIL

Under a new agreement between the federal and provincial governments the price of the average barrel of Alberta crude oil at the wellhead went from \$8 to \$9.05, July 1, 1976, and to \$9.75 on January 1, 1977. The \$1.05 rise did not affect the consumer until August 30, however, due to a 60-day freeze on produce prices to allow depletion of product inventories acquired at pre-July 1 prices. The final result for the consumer was an increase of 4 to 5 cents a gallon for motor gasoline and home heating oil.

As a result of the January 1, 1977 crude oil increase, a 2.3 cent a gallon price increase was authorized for gasoline and home heating oil and, in addition, the Anti-Inflation Board approved further proposed price increases to reflect changes in tax and other costs to the refiners. Even after the January 1, 1977 increase in the domestic crude oil price, that price was still

almost \$4 a barrel less than the average price of oil available on the world market.

OPEC

International prices were adjusted upward by members of the Organization of Petroleum Exporting Countries (OPEC), as of January 1, 1977. Eleven OPEC countries decided on a 10 per cent increase (about \$1.19) per barrel. Two other members (Saudi Arabia and the United Arab Emirates) increased prices 5 per cent (about 58 cents).

NATURAL GAS

Natural gas prices rose 15.5 cents at city gate, Toronto (for areas in the TransCanada Pipeline eastern zone), from \$1.25 to about \$1.405 per million Btu's on July 1, and rose a further 10 cents January 1, 1977 under the above agreement.

Energy Consumption and Conservation

NEW CAR STANDARDS

The federal government outlined new energy efficiency standards for cars. Mileage standards will require a fleet average performance of at least 24 miles per gallon by 1980 and 33 mpg by 1985.

P.E.I. GRANT

The federal government gave Prince Edward Island a \$12 million grant to encourage greater energy conservation. Key elements included \$6.940 million for a new home insulation program, \$1.585 million to encourage energy conservation in industry and commerce and \$3 million for studies on renewable energy forms. The latter program will study development of wood as an energy source and assess windpower potential and solar space heating. The federal government also began negotiations with Nova Scotia for an energy conservation package of loans and grants.

SAVE 10

The federal government began its internal "Save 10" program in an effort to cut energy consumption by 10 per cent during 1976 and keep it at that level for the next 10 years. The program included equipment overhaul, new building operation guidelines and advertising to encourage the employee to do his part. It was hoped the program would save taxpayers at least \$25 million during its first year.

INSULATION SALES TAX

The federal government and several provinces, including Ontario, Prince Edward Island, and Nova Scotia, dropped their sales taxes on insulation as an incentive for building retrofitting, and on certain devices designed to conserve energy or develop renewable forms of energy. Retrofitting could cut heat loss up to 50 per cent in individual homes. The average investment of \$880 could be paid back in five years or less.

BUILDING CODE PROPOSALS

The federal government prepared new guidelines for design and construction of energy-efficient buildings and proposed them for adoption into the National Building Code, which is a model code available for adoption by the provinces.

CMHC

The Central Mortgage and Housing Corporation modified its present loan and grant regulations to encourage reinsulation of existing homes.

IEA REPORT

A report published by the International Energy Agency—based on 1975 data—showed Canada, along with the United States, to have one of the highest rates of energy consumption in the world. The principal criticism of Canadian

policy was the fact that petroleum prices had not been permitted to reach world levels. Canadian energy consumption per capita is about twice that of many industrialized countries, including the United Kingdom and West Germany, more than three times that of Japan and one-and-one-half times that of Sweden. Contributing factors include Canada's cold climate, transportation distances, and the fact that Canadians for years enjoyed very low energy prices and were extravagant in the use of energy.

INDUSTRY

The manufacturing industries were well on the way to achieving goals set out by ten task forces formed early in the year. The groups involved account for 70 per cent of all industrial

energy consumed. The task forces set targets for reduction in energy consumed per unit of output by 1980. The targets range from 3 per cent for the ferrous metals to 15 per cent for transportation and 20 per cent for food products.

ONTARIO BUS

The federal government began planning a national program based on Ontario's energy bus scheme, which features a van equipped with demonstration devices, literature, qualified staff and a mini-computer to do on-the-spot energy audits to help industry cut energy use. The Ontario program indicated an average obtainable potential for reduction of 17 per cent in energy use.

Oil and Natural Gas Imports and Exports

SARNIA-MONTREAL PIPELINE

The 518-mile-long, \$240-million extension of the Interprovincial Pipeline from Sarnia to Montreal began continuous oil delivery in mid-June. By mid-November, a delivery rate of 250,000 barrels per day had been attained. Construction of this pipeline was encouraged by the federal government in order to help limit the dependence of Quebec on imports of oil at the world price. The opening of the line helped keep Canada's total crude oil imports below the 1975 level.

LLOYDMINSTER QUOTA

The National Energy Board reimposed an export quota on Lloydminster-type heavy crude oil, under which traditional export buyers were required to purchase a total of 25,000 barrels a day to obtain their maximum allocation of light and medium crude oils. The quota was designed to maintain a minimum level of production in the Lloydminster oil fields during the off-season.

HEAVY OIL LICENCE

The National Energy Board announced a separate licencing system for heavy oil, commencing January 1, 1977. The system will distinguish between the different types of crude oil. The decision came after the Board had held extensive hearings into matters relating to supply and requirements of the Canadian oil industry. A variety of proposals were presented, including one from the Independent Petroleum Association of Canada (IPAC) requesting a five-year exemption for heavy oil from any export restrictions.

CANADA-U.S. PIPELINE AGREEMENT

Canada and the United States held negotiations on a bilateral pipeline agreement which was signed in January 1977. It provides for non-interference and non-discrimination for transit pipelines carrying oil and natural gas destined for one country across the territory of the other. The agreement will not enter into force as a treaty until ratification by both countries.

Oil and Natural Gas Resources

FEDERAL LAND REGULATIONS

The federal government outlined a proposed policy with regard to changes in Canada's oil and natural gas land regulations. These changes will involve promulgation of enabling legislation—the Petroleum and Natural Gas Act—which is expected to be presented to Parliament in 1977. Under the proposed policy, participants in production licences would have to include a 25 per cent Canadian interest, and provision would be made for the participation of Petro-Canada under certain circumstances. Some other stipu-

lations were: a basic 10 per cent royalty plus a progressive incremental royalty on production, land tenure reductions, and ministerial discretion in such areas as ordering drilling and production.

OFFSHORE ADMINISTRATION

The federal government, Prince Edward Island, Nova Scotia and New Brunswick concluded negotiations for a memorandum of understanding on the administration of activities relating to mineral resources offshore from these

provinces and the division of revenues. Administration will be directed by a joint federal-provincial board. Shoreward of mineral resource administration lines, drawn at least five kilometres from the coast, the adjacent province will receive 100 per cent of the revenues. Seaward of the lines, the province will receive 75 per cent, with the balance going to the federal government. The memorandum opens the way for the conclusion of a formal agreement.

Northern Exploration

BEAUFORT SEA

Dome Petroleum Ltd. found indications of gas in the Beaufort Sea at one of its two offshore wells—the first ever to be drilled in Arctic waters using drillships. A small show of gas was encountered in sand at about 10,000 feet in the Tingmiark K-91 well just before the September 25 deadline for an end to drilling. The Dome drilling program was the first offshore exploration in the deeper waters of the Beaufort. By the end of the season, Dome had prepared surface holes for further wells. The company plans further tests in the 1977 summer season and was beginning a study of possibilities for winter drilling from land-fast ice for the 1977-78 season.

ARCTIC ISLANDS AGREEMENT

Arrangements for an \$80 million exploration program in Arctic offshore areas were concluded for permit lands held by Sun Oil Limited and Global Arctic Islands Ltd. The program should

ARCAN PURCHASE

Petro-Canada bought all outstanding shares of Atlantic Richfield Canada Ltd. (ARCAN) for \$340 million. The name of the company is now Petro-Canada Exploration Inc. All the Saskatchewan interests of the company had previously been bought by the Saskatchewan Oil and Gas Corporation.

help to revitalize petroleum exploration in the far north. Partners to the agreement were Imperial Oil Limited (with 35 per cent interest), Gulf Oil Canada Limited (25 per cent), Panarctic Oils Ltd. (22 per cent) and Petro-Canada Exploration Inc. (8 per cent).

PANARCTIC

Panarctic Oils Ltd. announced a deeper pool natural gas discovery off the Sabine peninsula of Melville Island and further development of an oil discovery on Cameron Island as part of the continuing assessment of the resource potential of the Arctic Islands.

ICE-CUTTING DRILLING RIG

Panarctic Oils Ltd. announced that it was developing specifications and design for a unique ice-cutting drilling rig capable of year-round operation in Arctic waters. Other special equipment to drill wells from reinforced ice platforms is also being developed.

Eastern Exploration

PETRO-CANADA

Petro-Canada spent about \$22 million to obtain an interest in nearly 20 million acres of permit lands in the eastern offshore. By the year's end it had become involved in four separate farmout agreements including the drilling of seven wells offshore from the Atlantic Coast and had started negotiations for three new programs near Sable Island, off Labrador and in Davis Strait. Other companies involved in these agree-

ments included Shell Canada Resources Limited, Mobil Oil Canada Ltd., Murphy Oil Company Ltd., and BP Exploration Canada Ltd.

LABRADOR

Total Eastcan Exploration Ltd. confirmed the presence of natural gas and condensate in its Snorri J-90 well 700 miles north of St. John's, on the Labrador Shelf.

Pipelines for Northern Resources

NEB HEARINGS

The National Energy Board began its northern natural gas pipeline hearings April 12. Three proposals are being considered. Canadian Arctic

Gas Pipeline Ltd. of Toronto and its U.S. affiliate, Arctic Gas, have proposed a pipeline from Prudhoe Bay, Alaska—east to the Mackenzie Delta then south along the Mackenzie Valley to

Canadian and U.S. markets. The Foothills Pipe Lines Ltd. consortium of Calgary has proposed an all-Canadian "Maple Leaf Line" from the Delta alone. Foothills Pipe Lines (Yukon) Ltd. has proposed the "Alcan" project to connect a trans-Alaskan pipeline to existing Canadian pipeline systems via the Alaskan Highway route. It would probably carry Alaskan gas to customers in the United States.

BERGER COMMISSION

The Berger Commission inquiry into a pipeline through the Mackenzie Valley wound up its 20 months of hearings in November. The Commission held exhaustive hearings on the environmental and social impacts of pipeline proposals. The report, expected in the spring of 1977, will recommend what conditions should be placed on the granting of a right-of-way for any pipeline construction.

Oil Sands and Heavy Oil Developments

SYNCRUDE

By the end of 1976, construction of the Syncrude Canada Ltd. project, located on the Athabasca oil sands near Fort McMurray, was 60 per cent complete, with operation scheduled to begin in early 1978. Expected final cost is still within five per cent of the \$2.048 billion forecast at the end of 1974. Capacity is set at 125,000 barrels of crude oil a day. A final agreement among the partners—Imperial Oil Ltd. (31.25 per cent), Canada Cities Service (22 per cent), Gulf (16.75 per cent), Petro-Canada (15 per cent), Alberta (10 per cent) and Ontario (5 per cent)—was signed by April.

AOSTRA

Alberta Sands Technology and Research Authority (AOSTRA) announced a \$130 million research program for the Alberta oil sands. Five field experimental projects to test advanced oil recovery concepts will be financed on a 50-50 government-industry basis. One contract was concluded by the year's end—the Amoco Canada Petroleum Company Ltd. development of a \$46 million pilot heavy oil extraction plant at Gregoire Lake. The four others are in the final planning and contractual stage.

OIL PIPELINE

The Beaufort-Delta Oil Project Ltd. shelved indefinitely its plans to develop an oil pipeline to southern markets from the Mackenzie Delta and the Beaufort Sea owing to a lack of oil finds in the region. First, however, the group completed an application for the venture and this could be presented to the National Energy Board should sufficient reserves be found.

KITIMAT PIPE LINE LTD.

Kitimat Pipe Line Ltd. of Calgary applied to the National Energy Board for permission to build a 753-mile, \$494 million crude oil pipeline from Kitimat, B.C. to Edmonton. It would carry Alaskan oil across Canada to northern U.S. refineries. The company hopes to construct the line during 1977-78, with first deliveries scheduled for April, 1979. This pipeline could also help fill unused capacity in the Interprovincial Pipeline, which serves markets in eastern Canada as well as give Canada a western option for foreign crude oil.

SURMONT IN-SITU PLANT

Work began on the first phase of the Numac Oil and Gas Ltd. experimental in-situ recovery process plant for oil from oil sands near Surmont, Alta.

GOVERNMENT INCENTIVES

Alberta and the federal government began talks on new tax and royalty incentives to encourage future oil sand development.

LLOYDMINSTER

October marked the signing of a \$16.2 million shared-cost program between the federal government and the province of Saskatchewan to develop new techniques for Lloydminster and similar oil fields. Proposals are to be sought from industry for testing new methods of heavy oil extraction, for conducting environmental assessments, for developing methods of making the oil suitable for pipeline transmission and developing new methods of processing the heavy oil. Present estimates of "in place" resources of heavy oil in the Lloydminster area—70 per cent of which lies in Saskatchewan—have been as high as 10-20 billion barrels. Only a few hundred million barrels are recoverable under present economic and operational conditions.

Other Canadian Petroleum Developments

DEEP DRILLING

Dome Petroleum's dual zone oil strike near Minton, Sask. provided the second example of deep drilling potential and encouragement for more drilling of deeper formations by other operators. The strike supported the theory that oil can be found in geological formations below some of Saskatchewan's existing producing areas. The well was the fourth in a series of six in a deep-drilling program in southeast Saskatchewan. The first well struck oil in late 1975—the first success in 570 attempts in the Winnipegosis Formation.

SUFFIELD BLOCK

The first sales of Suffield Block gas by the Alberta Energy Corp. were made in 1976. The 613,000-acre Suffield Block in southeastern Alberta is an area used by the federal government for military purposes. It is divided into six development areas. Strikes so far include five heavy oil successes. The drilling program began in the spring of 1976.

NEW ALBERTA LICENCE REGULATIONS

Alberta outlined its new Petroleum and Natural Gas Lease and Licence regulations. Shorter terms for leases and licenses, reductions in the

number of different sale types to two, and introduction of a concept of separate rights for "deep" drilling below existing oil and gas producing levels were among the highlights.

NORTHEASTERN BRITISH COLUMBIA

British Columbia took concrete steps to encourage development of the Grizzly Valley natural gas reserves in the northeastern part of the province by requesting that Westcoast Transmission Co. Ltd. of Vancouver extend its existing gathering system into the area.

OIL STORAGE

During the year, the abandoned Wabana iron ore mine on Bell Island, Nfld. was further considered for oil storage. Wabanex Energy Ltd. of Montreal, a subsidiary of the Power Corp. of Canada, has plans to convert the mine, which could hold up to 100 million barrels. Home Oil Ltd., Murphy Oil Co. Ltd. and North Canadian Oil Ltd. also proposed an underground crude oil storage development in a dissolved salt cavern on Cape Breton Island, N.S. Alberta rejected a proposal for the development of an extensive provincial network of underground oil storage areas in salt caverns.

Petrochemicals

MAJOR ADDITIONS FOR ALBERTA

\$420 million was committed during 1976 for two new petrochemical facilities at Fort Saskatchewan, Alta. Application from the Alberta Energy Company for a \$225 million benzene producing facility was heard by the Alberta Energy Resources Conservation Board. Application was also heard from Alberta Gas Trunk Line Co. Ltd. for a \$195 million benzene refinery.

TWO PLANTS

Work began on two major petrochemical plants in central Alberta, representing an investment of some \$500 million. Site clearing began for the \$261 million Dow Chemical of Canada Ltd. complex at Fort Saskatchewan. The complex, to include expanded chloralkali facilities, will produce 420 million pounds of ethylene glycol and 700 million pounds of vinyl chloride monomer a year. Construction started on the \$250 million ethylene plant of Alberta Gas Ethylene Co. Ltd. at Joffre, east of Red Deer, Alta. It will be connected to Fort Saskatchewan by a pipeline. Construction should be complete in 1978.

MEDICINE HAT

The Alberta Energy Resources Conservation Board conditionally approved an application by Alberta Gas Chemicals Ltd. of Edmonton to build the second \$62 million phase of its methanol from natural gas plant at Medicine Hat. Total capacity will be 840,000 tons (763,636 tonnes) a year. Production will begin in 1978.

SARNIA

Sun Oil Co. Ltd. completed its \$26 million aromatics unit at Sarnia. Major expansion for Sarnia, however, will come in 1977 with the completion of the \$650 million Petrosar petrochemical refinery and \$170 million Union Carbide Canada Ltd. polyethylene plant. The Petrosar operation will produce 1 billion pounds a year of ethylene, plus propylene, benzene and butadiene, as well as fuel products. It will require 170,000 barrels of feed a day when in full operation. In 1976, Alberta denied Petrosar Ltd. the opportunity to buy Crown petroleum by excluding it from the provincial marketing commission's list of 21 "approved buyers". Petrosar will have to buy its Alberta Crown petroleum through a third party. Also scheduled for completion in 1977 is the Cochin ethylene pipeline connecting central Alberta and Sarnia.

Coal

NATIONAL COAL POLICY

Initial discussion on a national coal policy began among the federal government and Alberta, British Columbia, Saskatchewan, Ontario, New Brunswick and Nova Scotia. Topics under discussion include an inventory of coal reserves, research programs on the conversion of coal to synthetic products (this includes gasification), and transportation and export policies that will assure domestic supplies. A full policy statement is expected in 1977.

WEST CENTRAL ALBERTA

Luscar Sterco Ltd. announced a new \$90 million open pit coal development in the Coal Valley, southeast of Hinton, Alta. The mine will produce just over 2.25 million tonnes a year, of which about 1.9 million will go to Ontario Hydro's thermal electricity plants. Final cost of the development, to include the mine, railway and blending facilities, is estimated at \$350 million. The contract is the first major commitment of Alberta coal for Ontario.

ONTARIO HYDRO

Ontario Hydro entered into a contract with Byron Creek Collieries of Corbin, B.C., for 500,000 (short) tons a year.

THUNDER BAY TERMINAL

Work began on a new \$45 million coal loading terminal at Thunder Bay, Ont., which, by 1980, will be transshipping about 3.25 million tonnes of coal annually, for Ontario Hydro, most of it from Western Canada.

Ontario Hydro will devote \$26 million to new facilities to blend coal from the United States and

Western Canada. Pennsylvania and West Virginia are still major suppliers with contracts for future deliveries of up to 12 million tonnes a year.

ALBERTA POLICY

A new coal policy for Alberta came into effect making sweeping changes in the royalty structure. The existing 10-cent-a-ton royalty was replaced by a formula that can take from a minimum 5 per cent to a maximum of 50 per cent of the total revenue as royalty. The act contains protection for recreational lands and zones the province into four development categories.

DEVCO

The Cape Breton Development Corporation (DEVCO) opened a new 2.9-million-tonne-a-year preparation plant near Lingan, N.S. The plant will wash coal from DEVCO's new Lingan mine to provide clean metallurgical coal for domestic and foreign steel industries.

SASKATCHEWAN MINE

The Saskatchewan Power Corporation began production from its Souris Valley surface mine near Estevan. At full capacity, the mine will produce about 364,000 tonnes of lignite annually for the new Poplar River power station.

B.C. STUDIES

Studies continued in British Columbia to determine the feasibility of developing the north-east region's coal deposits for offshore markets, notably as metallurgical coal for Japan. This project would involve development of mines, communities and a transportation system.

Uranium and Nuclear Power

FEDERAL-PROVINCIAL RECONNAISSANCE

The federal government announced that it had entered into shared-cost agreements with New Brunswick, Ontario, Saskatchewan and British Columbia for various airborne gamma-ray spectrometry and regional geochemical surveys under its Uranium Reconnaissance Program. The federal government will contribute about half of the total \$3,584,000 cost of surveys provided for under these agreements.

RABBIT LAKE

The Gulf Minerals Canada Limited — Uranerz Canada Limited joint Rabbit Lake operation in the Wollaston Lake area of Saskatchewan completed its first full year of production. This operation began in late 1975 as the first new

uranium production operation in Canada since the late 1950s.

KEY LAKE

A second new uranium orebody was discovered in mid-1976 at Key Lake, Sask., on the southeastern fringe of the Athabasca Sandstone Basin in a joint exploration project of Uranerz Exploration and Mining Limited, Inexco Mining Company (Canada) Ltd. and Saskatchewan Mining Development Corporation. The joint venture discovered the first orebody at Key Lake in mid-1975.

SASKATCHEWAN ROYALTIES

The Saskatchewan government announced a new two-part uranium royalty structure to be effective August 1, 1976. There is a basic royalty

of three per cent of the gross value of sales together with a graduated royalty. The marginal rate of tax will be determined on the basis of the net rate of return on capital invested in the project.

MADAWASKA

Production began again at Madawaska Mines Limited at Bancroft, Ontario under Italian export contract. The mine had been closed since 1964.

U.S. PROBE

Canada blocked the removal from Canada of information on uranium marketing activities during 1972-75. A demand for such information, served by the United States on U.S. companies as part of its probe into alleged international uranium price fixing, could have involved information from subsidiaries and affiliated companies in Canada.

AECB RADIATION STUDIES

The Atomic Energy Control Board investigated locations showing radiation readings that were higher than background (naturally occurring) levels in Port Hope, Ottawa, Toronto and Elliot Lake, Ont., Uranium City, Sask., and other communities. Waste, mostly from uranium mines, processing plants and research facilities, was the source of the problem in some instances. A major cause in Elliot Lake, Ont., was the bed of uraniferous conglomerate which occurred naturally in the rock running through the centre of the town. The clean-up in 1976 involved removal of waste from Port Hope, Ottawa and Toronto to other locations for storage.

HEALTH

A joint industry, government and labor panel began meetings to plan a research program into overcoming occupational and environmental health problems associated with uranium production. Members include the Atomic Energy Control Board, federal and provincial health and environmental agencies, Denison Mines, Rio Algom, Eldorado Nuclear and the United Steel Workers of America.

SASKATCHEWAN INQUIRY

Saskatchewan announced that it would set up a board of inquiry to investigate the implications of expanding uranium mining in the province, starting with a review of the Cluff Lake uranium mining project of the French-owned company, AMOK Ltd. The company had started development earlier in the year but stopped because of the announcement.

RADON

New federal guidelines were set for acceptable levels of radon gas for the general public.

Radon is a gas emitted naturally during the long process of disintegration of radioactive substances.

WASTE STORAGE

The Geological Survey of Canada started preliminary field investigations into the use of geological formations for future radioactive waste storage. Reconnaissance work was carried out in six areas. These formations include salt deposits and plutons—large bodies of hard igneous rock such as granite.

NUCLEAR LIABILITY ACT

The federal government promulgated the Nuclear Liability Act following six years of negotiations with the insurance industry. The Act requires operators of nuclear reactors to carry the first \$75 million in liability insurance.

STRONGER SAFEGUARDS

The federal government announced a further strengthening of safeguard requirements which apply to the export of Canadian nuclear reactors and uranium. The new policy requires that shipments to non-nuclear weapon states under future contracts be restricted to those countries that ratify the nuclear non-proliferation treaty or otherwise accept comparable international safeguards on their entire nuclear program, including technology developed in the country. By the end of 1976, South Korea and Finland had met the safeguards. There was an interim arrangement with the United States, some upgrading was required by Argentina and Spain, and negotiations were continuing with Japan and the European Economic Community. Aid to India and Pakistan has been dropped.

ONTARIO HYDRO

A ceiling on capital spending, imposed by the government of Ontario during the year, resulted in some postponements to plants for development by Ontario Hydro, the provincial electrical utility. This included delays in the construction of nuclear plants.

PORTER COMMISSION

The Porter Commission on Electric Power Planning in Ontario began its study of long term electrical plans for the province. A major part of this investigation is related to Ontario Hydro's commitment to nuclear power.

POINT LEPREAU

During 1976, the federal government approved a \$30 million loan instalment related to the federal undertaking to provide 50 per cent of the financing (up to a maximum of \$350 million) of the Point Lepreau, N.B., nuclear plant. This station, now about 35 per cent complete, is scheduled to come on stream in 1980.

PICKERING

The 2,000-megawatt Pickering Ont., plant became the world's leader in nuclear electrical production by producing more than 50 billion kilowatt hours since it was first commissioned in 1974.

BRUCE A

The number 2 unit of the new Bruce A station operated under test in preparation for com-

missioning in 1977, when it and unit 1, will add 1,500 megawatts to Ontario Hydro's electrical production. By 1979, four units will be on stream and the Bruce plant will become Canada's largest nuclear installation. Nuclear power provided approximately 19 per cent of Ontario's electrical consumption in 1976, or about 6 per cent of Canada's total consumption.

Electricity

MARITIME ENERGY CORPORATION

The Minister of Energy, Mines and Resources and the premiers of Nova Scotia, New Brunswick and Prince Edward Island, continued negotiations towards the establishment of a Maritime Energy Corporation. The announcement of an agreement in principle was made early in 1977. This Corporation would be concerned with the means of achieving optimal expansion of electric generation and supply in the Maritime provinces.

P.E.I. CABLE

A 30-year agreement to connect the electrical power networks of New Brunswick and Prince Edward Island was signed by the two provinces. Work will be completed in the summer of 1977 on the \$36 million project, comprising a 9-mile submarine cable installation across Northumberland Strait and related terminal and land-line facilities that will bring Prince Edward Island into the Eastern Canada Power grid. This project is being supported by the federal government through grants and loans totalling \$27 million. The Maritime Electric Company of Charlottetown will purchase power from the New Brunswick Electric Power Commission. All of Prince Edward Island's electricity now comes from thermal plants fuelled by imported oil.

CHURCHILL FALLS

Proceedings began in the Newfoundland Supreme Court over the terms of the water licence pertaining to the Churchill Falls hydro development. Under a 1969 agreement with the Churchill Falls Labrador Corp., Hydro-Quebec has contracted to buy for 65 years virtually all the output from the 5,225 megawatts project, except for 300 megawatts that Newfoundland may recall for use in Labrador.

GULL ISLAND

Newfoundland has deferred development of the Gull Island hydroelectric power site on the

lower Churchill River. The project potential is 1,800 megawatts and costs for the power plant and transmission are now estimated at \$2.3 billion. Related facilities would include over 500 miles of DC transmission line and an 11-mile tunnel and power cable under the Strait of Belle Isle to transmit the power from the central Labrador site to Newfoundland. The federal government has offered a long term loan for 50 per cent of the capital cost of the transmission facilities to a maximum of \$343 million. A committee, representing utilities of the four Atlantic provinces, has suggested that the project become a regional development item.

REVELSTOKE DAM

Tenders opened for B.C. Hydro's \$1.2 billion Revelstoke dam on the Columbia River. At full capacity, the 535-foot-high, one-mile-long structure will create a lake stretching 80 miles to the foot of the Mica Dam. With an installed capacity of 2,700 megawatts when completed, it will be the largest hydroelectric development in the province.

QUEBEC SURPLUS

The National Energy Board approved the export of up to 800 megawatts of summertime surplus energy from Quebec to New York for five years definite. A time extension is allowed conditional upon security of provincial supplies.

MANITOBA TRANSMISSION LINE

Manitoba Hydro completed a 105-mile transmission line to the border with Minnesota for export and import of surplus energy under a 10-year agreement with the Minnesota Power and Light Co.

CHURCHILL RIVER STUDY

A three-year Saskatchewan-Manitoba study on the possible social and environmental effects of a power generation station on the Churchill River was released.

Research and Development

INCREASED FUNDS

Federal government funding for energy research and development was increased in March, with an additional \$10 million supplement to the 1975-76 fiscal year funding. This new funding increased the total expenditures on energy R&D for 1976-77 to \$128 million, distributed in six areas: conservation, liquid and gas fuels, coal, nuclear energy, renewable energy, and the transportation and transmission of energy. Highlights of the program included: \$1 million for solar, wind and geothermal energy R&D; \$1.8 million for more efficient energy use in commercial buildings, residences and transportation systems, and for other energy conservation projects; \$1.5 million for oil sands and heavy oil R&D; \$2.5 million for coal gasification, liquefaction, mining technology, cleaning coal and better use of coal; \$1.1 million for the expansion of the nuclear fuel resource base; and \$1.7 million for transportation of energy commodities and transmission of electrical power.

FUNDS FOR ALBERTA

The transfer of \$4 million in federal funds to the province of Alberta for energy research projects was announced in December. The funding arrangement arose out of a March 1974 Energy Conference as part of a federal-provincial agreement on oil pricing. Ultimately a total of \$96 million will be transferred for this purpose.

COAL INTERNATIONAL

In March, Canada signed an agreement in Paris to participate in the work of three coal research services being established under the International Energy Agency's R&D program. To take maximum advantage of Canada's IEA participation, consultations were held with the provinces interested in coal and with the coal industry through the Coal Association of Canada. These services are expected to be active in the fields of economic assessment, technical information and coal mining technology.

COAL GASIFICATION

Canada's first *in-situ* coal gasification pilot project got underway in Alberta at an initial cost of \$450,000. At the site of the seam, 80 miles southeast of Edmonton at Forestburg, air is injected at high pressure to start combustion to produce low Btu (80-250 value) synthetic gas.

ADVANCED ELECTRIC GENERATION

A three-volume report based on a study commissioned by B.C. Hydro and EMR provided a comparison of advanced methods of generating electrical power and of coal gasification

using coal from the Hat Creek deposits in B.C. The summary report compared the economics of processes considered and identified a number of pilot projects of value in developing coal utilization processes in British Columbia. Feasibility studies in these areas are continuing.

GOVERNMENT GRANTS

Grants totalling \$259,050 for funding non-government research and development in the energy field were announced in August as part of EMR's Research Agreements Program. Approval was given to 21 proposals to conduct studies into such subjects as solar energy, the heating efficiency of buildings and the capacity of the coal industry to meet increased demand.

DISTRICT HEATING

The feasibility of using the European concept of district heating for North Pickering, a proposed community near Toronto to have a population of 80,000 by about 1995, came under study. Surplus, off-peak nuclear power from the Pickering nuclear plant could be used to heat water which would circulate throughout the system in such a way that it would never come into contact with any nuclear source. A separate energy-producing plant could be built initially and the system switched over to the nuclear heat at a later date.

SHARING THE SUN

Winnipeg hosted the "Sharing the Sun" conference in August. The conference, organized jointly by the Solar Energy Society of Canada and the American Section of the International Solar Energy Society, attracted more than 1,200 delegates from around the world. Over 350 papers were presented at six parallel sessions with proceedings published in ten volumes.

ARK

The P.E.I. "Ark", an experimental bioshelter (self-contained environmental system) that incorporates a family dwelling, greenhouse and aquaculture (fish-rearing) unit, was officially opened by Prime Minister Trudeau in September. The complex will use solar energy, wind and wood power, and the greenhouse and fish cultures to supply all heating, electrical and food needs of the inhabitants. The project, sponsored by the non-profit new Alchemy Institute, was funded by the Department of the Environment through a \$354,000 Federal Urban Demonstration Project grant. Continuing support will be provided under a federal-provincial research agreement with P.E.I.

MAGDALEN WINDMILL

A large windmill, 180 feet high with an aluminum rotor, 120 feet high and 80 feet in diameter, was ready to be installed on the Magdalen Islands for generation of electrical energy. The experimental windmill is a joint project of Hydro-Quebec and the National Research Council. If the 200-kilowatt turbine is successful an even bigger model, a one-megawatt turbine, will be built for the region.

SOLAR HEATING CONTRACTS

Contracts worth \$229,000 were awarded in November for the design and installation of solar heating systems in 14 demonstration houses across Canada. These contracts were funded by the National Research Council as part of the federal government's expanded R&D program. Solar heating projects had already been funded in Toronto, Mississauga and Gananoque, Ont., and for "The Ark" at Spry Point, P.E.I.

GEO THERMAL

A preliminary report of a resources study, undertaken for the Earth Physics Branch of EMR, suggested possible use of geothermal energy from sedimentary basins in the prairie provinces. Hot water from porous rocks beneath the prairies might one day be tapped as a source of energy for heating some Canadian homes. The recoverable energy could equal from 15 to 150 million barrels of oil from sources ranging in area from ten to a hundred square miles, each with typical lifetimes of 30 years.

TIDAL POWER

A preliminary report on the \$3 million tidal power study, funded jointly by the governments of Canada, Nova Scotia and New Brunswick, was released in November. It concluded that the Bay of Fundy tides could provide economically feasible power under the right set of circumstances. However, these will not likely occur within the next decade.

BIBLIOGRAPHY

More than one hundred energy and energy-related publications are available to the general public, either free of charge from the Department of Energy, Mines and Resources, or at a nominal charge from the Government Publishing Centre, Ottawa K1A 0S9. Listed below are some recent publications:

An Energy Strategy for Canada: Policies for Self-Reliance (Summary). (1976, 32 pages) (No charge).

An Energy Strategy for Canada: Policies for Self-Reliance. (1976, 170 pages) (Canada: \$2.50; other countries: \$3.00).

Keeping the heat in—How to re-insulate your home to save energy and money. (1976, 112 pages) (Office of Energy Conservation) (No charge).

Oil and Natural Gas Resources of Canada 1976 (76 pages) and *Oil Sands and Heavy Oils: the prospects* (36 pages) (Combined volumes—Canada: \$3.00; other countries: \$3.60).

Energy: The Task Ahead—Policy Questions and Answers. (1976, 48 pages) (No charge).

For further information about energy publications, write to:

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